Use of Neurobit equipment in BrainBay

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Introduction

This document gives an overview on the provided functionality of the BrainBay biofeedback software regarding *Neurobit Lite, Optima 2 and Optima 4* biosignal measurement devices. To understand the wider concept of BrainBay configurations and how to design different configurations for visual and audio feedback of biosignal parameters, please refer to the BrainBay User Manual (http://brainbay.lo-res.org/ or the help pages which are accessible in the main menu).

System Requirements

The Software setup has been tested with the following operating systems:

- Windows XP professional and Home edition
- Windows 2000/NT
- Windows Vista
- Windows-7 professional and Home edition

BrainBay has been reported to work on Linux using the Windows Emulator *WINE,* although this has not been verified in course of the Neurobit integration.

The minimum hardware requirements are:

- Pentium-2 Intel-compatible CPU
- 256MB RAM
- 30 MB free Hard disk or non-volatile memory
- Fully compliant Bluetooth Adapter

It has been revealed that not all commercially available Bluetooth dongles are fully supported by Windows. As a result the application cannot create connection with Neurobit device. To avoid this problem, choose a dongle working with Bluetooth drivers from Microsoft (available in the system) or from Widcomm/Broadcom (for example, dongle by *DeLock* works correctly).

Of course, the computing requirements differ according to the desired BrainBay configuration and the sampling rate of the biosignal acquisition device. On a Laptop with dual-core Intel CPU, designs which utilize multiple channels and display windows at 2kHz sampling rate can run with about 7% CPU occupation.

The Neurobit Element

The Interface to the Neurobit device is provided by the Signal-Source block „*Neurobit Amplifier*",
which can be inserted into the existing design by selecting „*Insert Element*" -> „*Source*" from the
main menu. (Currently, only one „*Neurobit Amplifier*" element can be active in a design.)
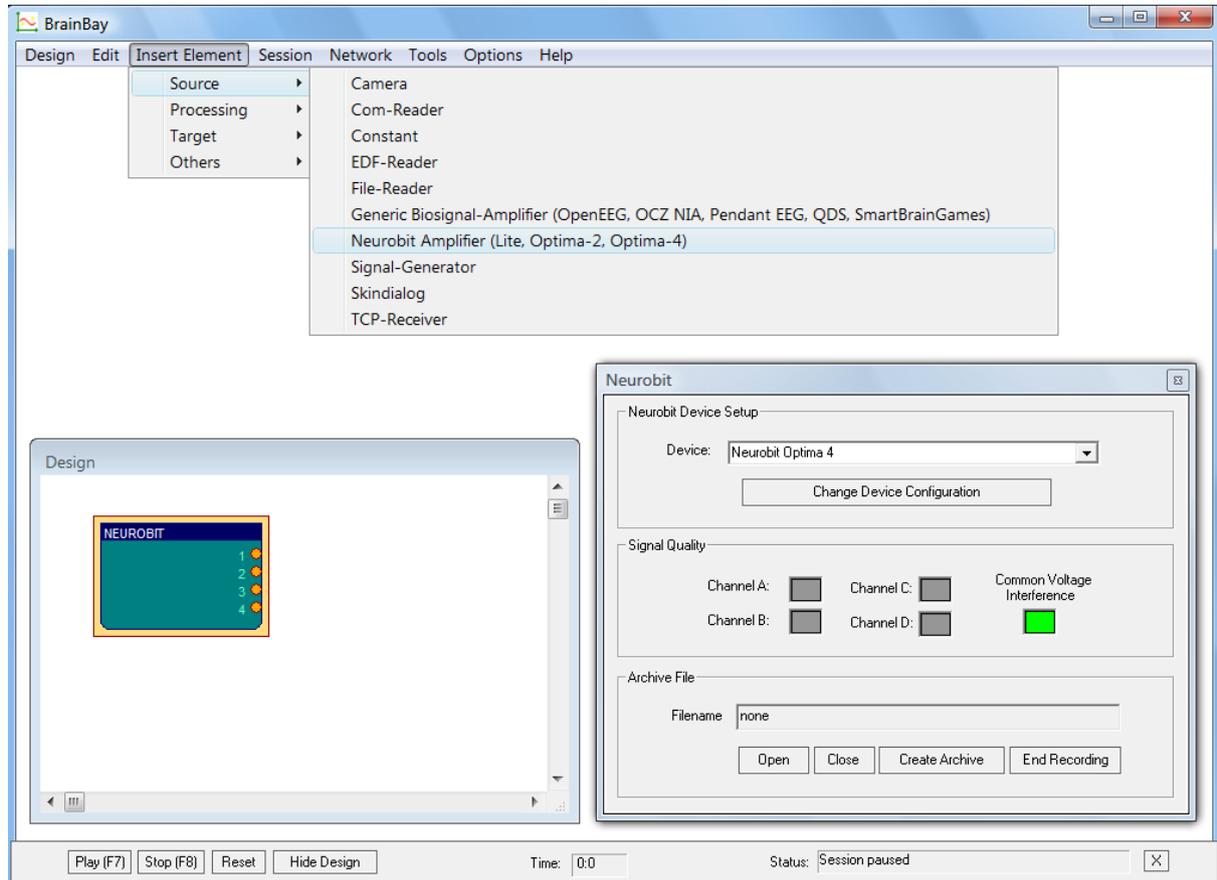
The new Neurobit element has set default device configuration (among other things, for Optima
devices all channels are initially inactive). By right-clicking the element in the Design window, the
element properties appear in a separate window. The Neurobit element offers the following
properties and functions:

- A Selection box to choose the desired device model (Lite, Optima 2 or Optima 4)
- A buttons to change Neurobit device configuration (the active channels, channel functions,
  captions, ranges, etc.)
- Signal quality indicators for individual channels and common voltage interferences
- Four buttons to play or record biosignal archives
  (create a new archive, open an existing archive, close archive)

Device Setup

The hardware settings of the Neurobit device can be changed by pressing the button „**Change Device Configuration**" in the properties window of the Neurobit element: the user dialog for channel setup is displayed and various properties can be set or modified, including:

- Channel activation / deactivation
- Channel label and Sensor Info
- Channel profile (e.g. presets for EEG, EMG, HRV, GSR, Temperature)
- User defined channel features (function, frequency characteristics, measurement range, sampling rate)
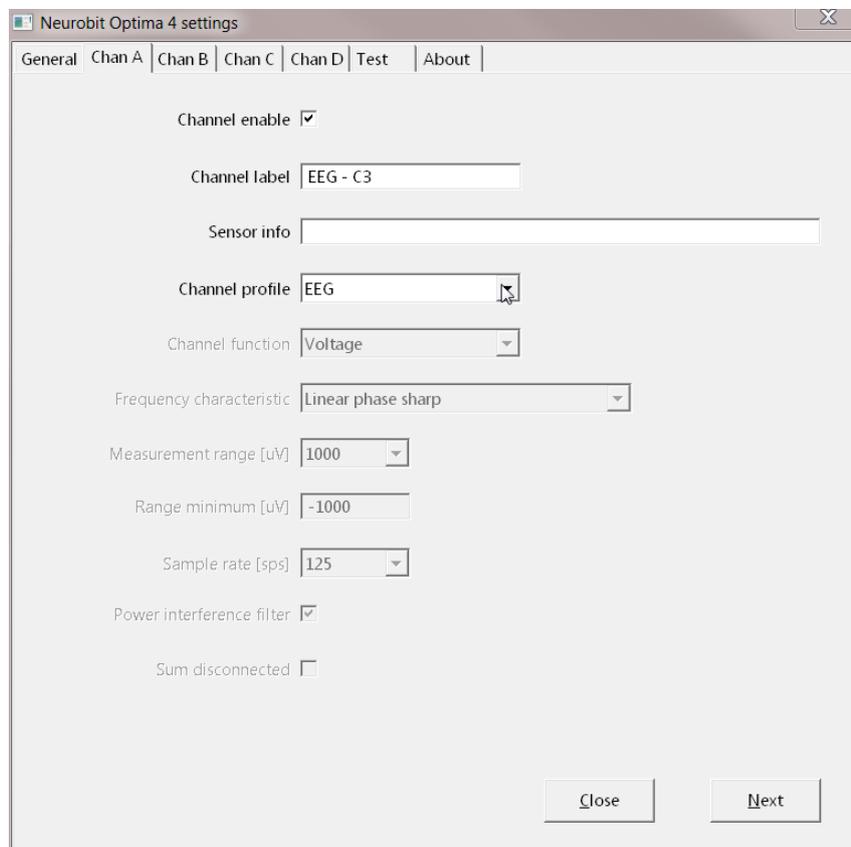
Furthermore, some general device parameters (e.g. optional address) and quality of input connections can be tested. Help regarding device settings is available on About tab of the device window.

The device settings are reflected in the BrainBay design in the following way:

- The channel label is visible as channel caption in the Neurobit element.
- The channel properties (range, unit) are copied to the signal properties of the Neurobit element's output ports (thus, the correct units are displayed e.g. in the Oscilloscope).

- The sampling rate of the BrainBay design is set to the maximum sampling rate of all active channels (see main menu -> „*Options*") .

Device setup is stored together with BrainBay design with, using menu option „*Design*" -> „*Save design*" and is restored when a design is opened with „*Design*" -> „*Load design*".

HINT: Neurobit device setup is stored in a separate file with main name as for corresponding BrainBay design file (*.con)* and name extension „*.nb*". If you would like to copy or move a design file *.con* manually, you should also copy/move corresponding Neurobit setup file *.nb.*

Data Acquisition

To connect with the device and start data acquisition, press the button „**Play (F7)** " in the BrainBay control-and-status bar. At this time, the Neurobit device should be turned on and the green power led should light up.

Given that the Bluetooth connection to the device is available and the device is ready to send data, the data acquisition starts and the number of received samples per second can be monitored in the BrainBay status line. During data transmission, the signal quality of the channels can be monitored inside the Neurobit element's properties window. Four colored fields indicate current signal quality, where **green** means *good contact*, **yellow** means *poor contact quality*, **red** means *signal overrange* and **purple** means *signal overload*. **Grey** color indicates that the channel is not active.

The following figure shows four connected channels with good signal quality:
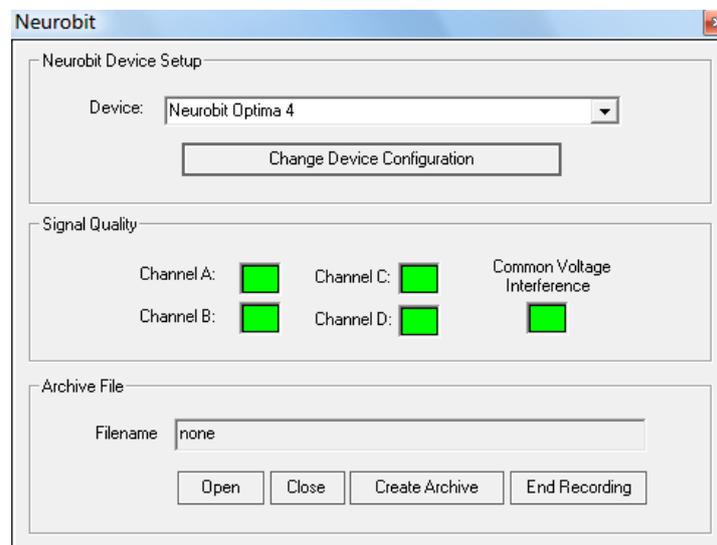
Note: during measurement Neurobit device configuration cannot be changed.

By pressing „**Stop (F8)**" in the control-and-status bar, live data acquisition is stopped.

Archive Files

To allow recording of biosignal data, BrainBay offers various options including the *EDF-writer* and the *File-Writer* elements. However, for the convenience of the user, the Neurobit element features a separate archive function, which allows archive file recording and playback from within the Neurobit element. This has the advantage that one particular design configuration can be used to record live data and to playback archived data without need for an additional element.

To record live data of the Neurobit device to a file, press the button „**Record**" in the Neurobit element properties window and enter a filename. The default directory for the recording will be „*../Archives/...*". As soon as the file has been created, all live data coming from the device will be stored into this file, until the recording is closed by pressing „**End Recording**".

An existing archive file can be played by pressing „**Open**" and selecting a file.

Please note that no live data from the Neurobit device will be provided by the Neurobit element as long as an archive file is open – all channel data is loaded from the file in this case. The playback of an archive file is stopped by pressing „**Close**" – which also reactivates live capture from the device.

Relevant BrainBay parameters

Update rates and global sampling rate: For a given Neurobit hardware setup, some parameters of the overall BrainBay software setup are interesting: Depending on the sampling speed, the user may want to change the update rate of data displays and user dialogs in the „Options" menu accordingly:
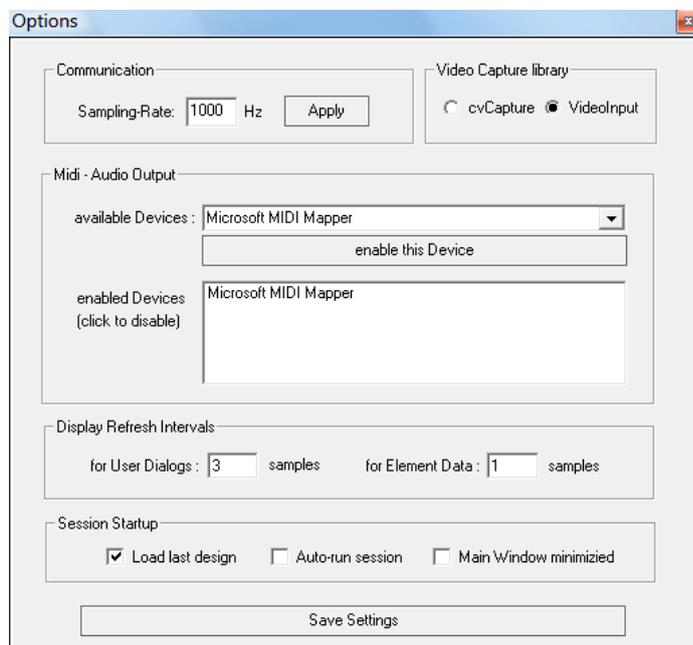

The options shown in this screenshot set the update rate for user dialogs (e.g. property windows of elements) to a period of 500 samples and the update rate for element data (e.g. FFT-spectrum displays) to 50 samples. For a sampling rate of 1000Hz (as in this case) this means that user dialogs are refreshed twice a second and element data is updated 20 times a second.

In another design where e.g. only 15 Hz GSR data is transferred from the device, it is reasonable to set both values to 1.

Please note that refreshing element data like FFT-windows every incoming sample would cause excessive CPU load if the device is set for a fast sampling rate of e.g. 1kHz!

Channel descriptions and ranges

By right-clicking an input- or output port of a BrainBay element, the properties of the channel (channel description, signal range) can be adjusted. The channel description and range are displayed e.g. in the Oscilloscope window:
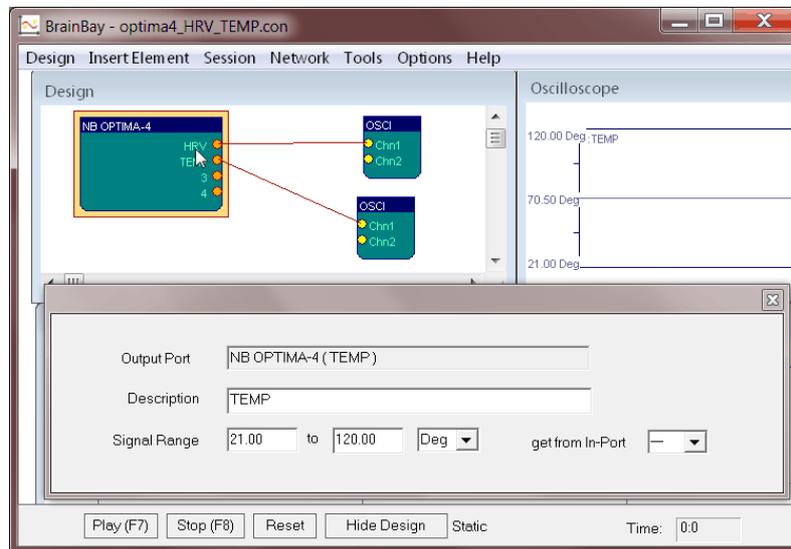
Signal ranges can be copied from a selectable input port if applicable.

Example designs

Following example design configurations are provided with BrainBay along with their corresponding Neurobit device setup files in CONFIGURATIONS\Neurobit\Tests folder:

Optima4_EEG_ECG_GSR.con

This configuration features two EEG channels with 125 Hz sampling rate, one ECG/HRV channel and one GSR channel. A FFT spectrum analysis of channel 1 is displayed, and the raw signals of both EEG channels and the ECG channel are shown in an Oscilloscope. The GSR values are shown in a separate Oscilloscope with slower trace.

Optima4_4EEG.con
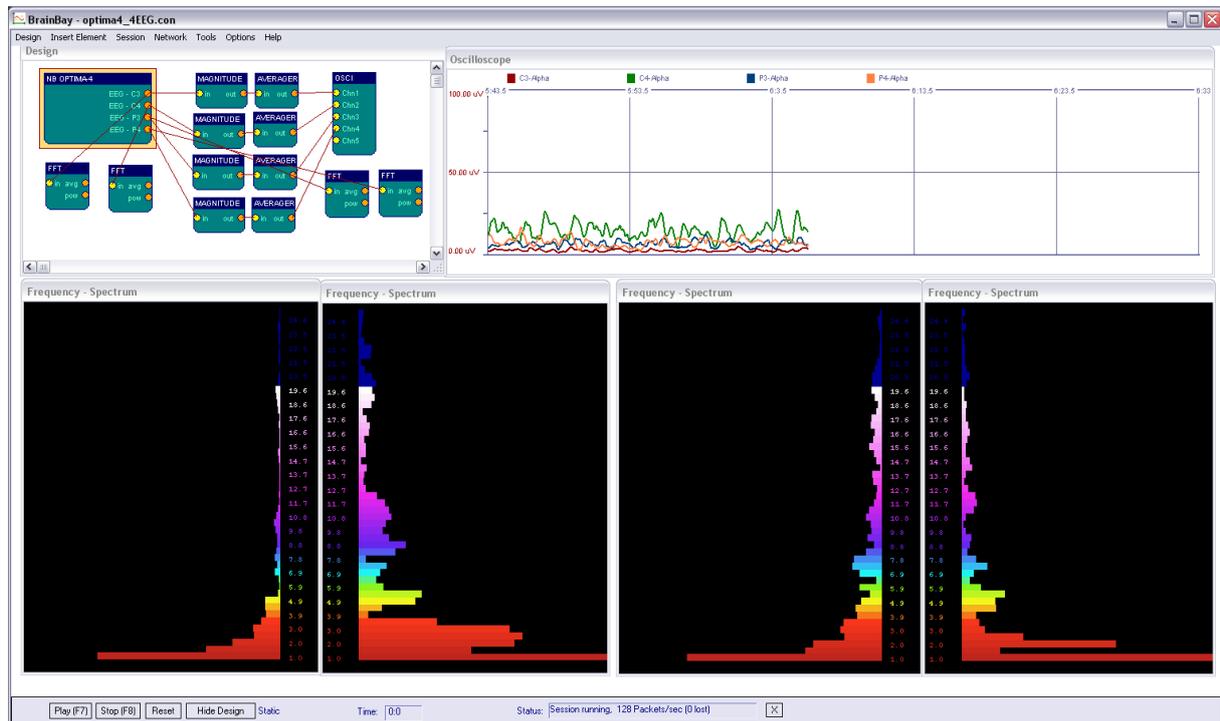
This configuration features 4 EEG channels sampling at 125 Hz. A bandpass filter in the Alpha-range is applied to each signal and the values are averaged and displayed in a group oscilloscope window. Below, a spectral analysis in the range of 25 Hz is shown for each channel.

Optima4_GSR.con
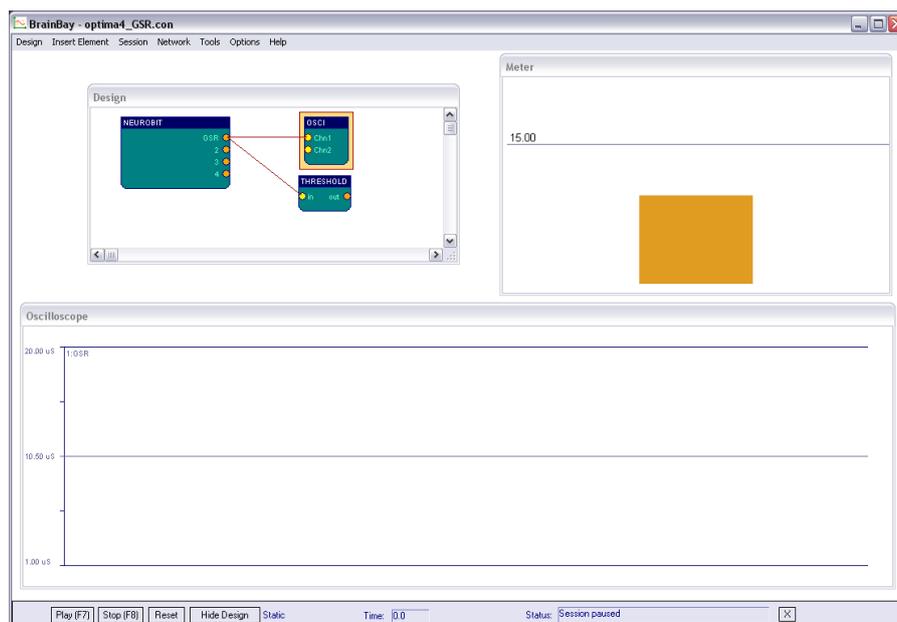
This simple setup provides one single channel of GSR with 15 Hz sampling frequency.

Use of other BrainBay example designs

In order to use example BrainBay designs initially created for OpenEEG device (available in CONFIGURATIONS folder) it is necessary to replace EEG element with Neurobit element, connect its outputs and suitably configure Neurobit device channels. Changes of time and signal range parameters in other design elements may be required for correct signal processing and presentation. It is recommended to set similar sampling frequency as set originally for EEG element, in order to limit necessary design changes. Saving of modified design in CONFIGURATIONS\Neurobit folder is advisable.

Known issues

- Currently only one device can be present in the design configuration.
- The archive file processing is not locked to the global session time.
- IMPORTANT: When Magnitude element is used, it should be taken into account that its "Width" property specifies <u>half</u> of pass-band width (description of that parameter in BrainBay 1.7 manual is false). Thus, to get magnitude in brainwave Alpha band (8-12 Hz) for example, "Width" should be set to 2 (and "Center" should be 10).